

SECURITY SYSTEM USING MOBILE PHONE

Field of the Invention

5 The present invention relates to security systems using video mobile phones, and more particularly to a security system using a video processor of the video mobile phone to detect motion.

Background of the Invention

10 As crime rates continue to increase, so too does the need for improved security systems. Some security systems utilize an extra camera that has a charge-coupled device ("CCD") for sensing motions and sounds. With the camera, the security systems detect a moving object and sound to determine whether either is beyond a threshold value. If a motion or sound is beyond a threshold value, the
15 security system alarms to notify a user and/or stores the video frames relevant to the alarm.

Employing such security systems requires relatively expensive apparatus and installation work. Therefore, the security systems may not be practically used in general home and office applications despite their functionality.

5 Summary

These and other drawbacks and disadvantages of the prior art are addressed by an apparatus and method for providing security with a video mobile phone. A security system with a video mobile phone includes motion detection.

Embodiments of the present invention provide a security system for sensing an
10 external moving object using a video processor mounted in a video mobile phone, and transmitting an alarm signal and alarm-related video frames.

According to an aspect of the invention, a security system using a mobile phone includes a video mobile phone having a security function for capturing external images and determining changes from the captured external images to transmit alarm
15 control signals and video frames, an alarm generator for receiving the alarm control signals from the video mobile phone to generate an alarm, and an alarm video

storage device for receiving and storing the alarm video frames transmitted from the video mobile phone.

Brief Description of the Drawings

5 The present invention may be better understood in accordance with the following exemplary figures, in which:

FIG. 1 is a schematic diagram showing a security system using a video mobile phone in accordance with principles of the present invention;

FIG. 2 is a flowchart showing the operations of the security system of FIG. 1;

10 FIG. 3 is a block diagram showing an embodiment of the security system of FIG. 1;

FIG. 4A is a block diagram showing a first embodiment of the video processor illustrated in FIG. 3;

15 FIG. 4B is a block diagram showing a second embodiment of the video processor illustrated in FIG. 3; and

FIG. 5 is a block diagram showing a decoder circuit of the video processor employed in restoring a DC coefficient and a motion vector for generating compressed video frames in the second embodiment illustrated in FIG. 4B.

5 Detailed Description of Preferred Embodiments

A security system with mobile phone is provided for enabling motion detection. Embodiments of the present invention provide a security system for sensing an external moving object using a video processor mounted in a video mobile phone, and transmitting an alarm signal and alarm-related video frames.

10 In a preferred embodiment, a security system using a mobile phone includes a video mobile phone having a security function for capturing external images and determining changes from the captured external images to transmit alarm control signals and video frames, an alarm generator for receiving the alarm control signals from the video mobile phone to generate an alarm, and an alarm video storage device
15 for receiving and storing the alarm video frames transmitted from the video mobile phone.

FIG. 1 is a schematic diagram showing a security system embodiment using a video mobile phone, and FIG. 2 is a flowchart showing the operations of the security system of FIG. 1.

As shown in FIG. 1, a security system using a video mobile includes a security threat 100, a video mobile phone 102 for observing the security threat, an alarm video storage device 104 in signal communication with the video mobile phone, and an alarm generator 106 in signal communication with the video mobile phone.

Turning to FIG. 2, the security system using a video mobile phone of FIG. 1 includes a function block S202 for setting a security mode, which passes control to a function block S204 for receiving input video frames. The block S204 passes control to a function block S206 for comparing and processing video frames, which, in turn, passes control to a decision block S208 that checks for movements.

If movements are not detected, control is passed back to the function block S204. However, if movements are detected, control is passed to a function block S210 that initiates an alarm. The function block S210, in turn, passes control to a function block S212 that stores alarm video frames.

Thus, the security system embodiment of FIGS. 1 and 2 disposes a video mobile phone 102 having a security function in the path of an expected invasion and sets a security mode (step S202). In the security mode, the video mobile phone 102 receives images captured by an included camera into the video mobile phone (step
5 S204).

The video mobile phone 102 compares the video frames of the external images (step S204) to determine whether there is an invasion 100 (step S208). If there is an invasion 100, the video mobile phone 102 may notify a security service or police, or call to a predefined telephone number using radio communications, and
10 also generates an alarm (step S210) with an alarm generator 106. At the same time, the video mobile phone 102 transmits the captured current external images wirelessly to alarm video storage devices such as a server of the security service, an adjacent computer, or camcorder, thereby preserving the evidence. If there is no invasion, the video mobile phone repeats the comparison operation until the security mode is
15 canceled by a user.

FIG. 3 is a detailed block diagram showing the video mobile phone of the present invention.

Turning now to FIG. 3, a security system embodiment using a video mobile phone includes a mobile phone having a video input device 302 and a video processor 304 in signal communication with the video input device. The video mobile phone further includes an alarm controller 306 in signal communication with the video processor. The alarm controller of the video mobile phone is in signal communication with an alarm generator 106, while the video processor is in signal communication with an alarm video storage device 104.

As described above, the video mobile phone of the FIG. 3 operates the security function using a video processor mounted in the existing video mobile phone, which includes a video input device 302, a video processor 304 and an alarm controller 306. The video input device 302 utilizes an installed camera to capture the external images and inputs video frames IS of the captured external images into the video mobile phone 102 of FIG. 1. The video processor 304 compares the video frames IS inputted from the video input device 302 to generate the result values RIC with respect to the difference between the frames, and converts the video frames IS according to input control signals. The alarm controller 306 controls the alarm according to the result values RIC generated by the video processor 304.

When the security mode is set in the video mobile phone 102 employed in the security system of FIGS. 1 or 3, the video input device 302 of the video mobile phone 102 of FIG. 1 captures the external images with the installed camera and then continuously inputs the captured video frames IS into the video mobile phone 102.

5 The video processor 304 compares the video frames continuously inputted from the video input device 302 to determine whether there is a moving object, and generates the result values RIS. In addition, the video processor 304 compresses and transmits the video frames IS according to the control signals CTR from the alarm controller 310 to an alarm video storage device 104.

10 Figs. 4A and 4B are block diagrams showing embodiments of a video processor 304 according to the present invention.

As shown in FIG. 4A, a first embodiment video processor 304 includes a video converter 402a for receiving first and second input signals and providing a first output signal. The video processor 304 further includes a video storage device 404a for receiving the second input signal. The video storage device 404a is in signal communication with a video comparator 406a, for providing a second output signal.

Thus, the video processor embodiment 304 of FIG. 4A includes a video storage device 404a, a video comparator 406a and a video converter 402a. The video storage device 404a stores the original video frames IS inputted from the video input device 302 or the sampled original video frames. The video comparator 406a compares the video frames IS2 stored in the video storage device 404a to generate the result values RIS of comparing. The video converter 402a generates the compressed video signals CIS of the original video frames IS according to the control signals CTR.

FIG. 4B is another embodiment of the video processor 304 for generating the result values of a comparison using the compressed video frames AIS generated from the compressed video signal CIS.

Turning to FIG. 4B, a second embodiment video processor 304 includes a video converter 402b for receiving first and second input signals and providing a first output signal. The video converter is in signal communication with a compressed video generator 404b. The compressed video generator 404b, in turn, is in signal communication with a video comparator 406b, for providing a second output signal.

Thus, the second embodiment video processor 304 of FIG. 4B includes a video converter 402b, a compressed video generator 404b and a video comparator 406b. The video converter 402b compresses the original video frames IS to generates compressed video signals CIS and generates the compressed video signal CIS according to control signals CTR. The compressed video generator 404b generates compressed video frames AIS using a DC coefficient of compressed video signal CIS generated during decoding in the video converter 402b and motion vector MV. The video comparator 406b compares the compressed video frames AIS to generate result values RIS of comparing.

FIG. 5 is a block diagram showing a decoder circuit of the video processor 304 employed in restoring DC coefficient and motion vector for generating compressed video frames AIS in the embodiment illustrated in FIG. 4B.

Turning now to FIG. 5, a decoder circuit of the video processor 304 of FIG. 4B includes a variable length decoder 502 for receiving a first input. The variable length decoder is in signal communication with an inverse quantization unit 504, which, in turn, is in signal communication with an inverse DCT unit 506 that provides a first non-inverted input to a summing unit.

The variable length decoder 502 is in further signal communication with a first input of a compressed video generator 404b. A second input of the compressed video generator 404b is in signal communication with the inverse quantization unit 504, the compressed video generator 404b for providing a compressed video output.

5 The variable length decoder 502 is additionally in signal communication with a first input of a motion compensator 508, the output of which is in signal communication with a second non-inverting input of the summing unit. The output of the summing unit is for providing restored video, and is in signal communication with a second input of the motion compensator 508.

10 Thus, the compressed video signal CIS is restored to the original video frames by the decoder circuit illustrated in FIG. 5, the compressed video signal CIS being compressed, for example, in accordance with motion picture expert group ("MPEG") or joint picture expert group ("JPEG") standards by the video converter 402b of the video processor 304.

15 That is, when the compressed video signals CIS are input, a variable length decoder 502, an inverse quantizer 504 and an inverse discrete cosine converter 506 of the decoder circuit apply intraframe compression to each frame of the original

video frames. A motion compensator 508 using a motion vector MV, generated by the variable length decoder 502, applies interframe compression to the continued original video frames. Thus, the original video frames are restored.

In the above restoring process, the compressed video generator 404b generates compressed video frames AIS using the DC coefficient restored by the inverse quantizer 504 and the motion vector MV generated by the variable length decoder 502.

The video comparator 406a or 406b of FIGS. 4A or 4B, respectively, compares the correlation between input video frames IS2 or AIS with a threshold value defined by a user to determine whether there is a moving object. In this case, the correlation between the video frames can be obtained by a summation of absolute values of differences between the pixel luminance $Y_t(i, j)$ of current video frames and the pixel luminance $Y_{t-r}(i, j)$ of arbitrary previous video frames, as described in the following formula:

$$\sum_{i=0}^N \sum_{j=0}^M |Y_t(i, j) - Y_{t-r}(i, j)|, \quad (1)$$

where N and M are sizes of vertical or parallel axes of a video frame, and (i, j) are the coordinate values of a pixel.

If there is no change in the input video frames, the correlation between the two video frames used in the formula 1 increases to make the value of the formula 1 approximate "0". However, if there is a moving object, the correlation between the two video frames decreases, such that the value of the formula 1 drastically increases. The current video frame $Y_t(i, j)$ may be compared with the adjacent previous video frame $Y_{t-1}(i, j)$. However, when there is only a slight motion, the value of formula 1 may increase linearly and decrease within the limitation of threshold value defined by a user. As a result, the invasion may not be detected. Thus, as referred to the formula 1, even slight motion may be detected by comparing the current frame with an alternative one (e.g., $Y_{t-r}(i, j)$) of the previous frames.

The video comparator 406a or 406b compares the video frames to each other in the above manner and generates the result values RIS of comparing to an alarm controller 306. The alarm controller 306 generates control signals CTR according to the input result values RIS. If a moving object is detected as a result of the comparison, the alarm controller 306 inputs control signals CTR for alarming to the alarm generator 106 and the video processor 304. According to the control signal

CTR, the alarm generator 106 alarms and the video processor 304 compresses the input external images to transmit to the external alarm video storage device 104. The transmitted video is stored in the alarm storage device 104 to be used as evidence.

Thus, embodiments of the present invention provide an effective security

5 system without additional installation work and with low cost. These and other features and advantages of the present invention may be readily ascertained by one of ordinary skill in the pertinent art based on the teachings herein. It is to be understood that the principles of the present invention may be implemented in various forms of hardware, software, firmware, special purpose processors, or combinations
10 thereof.

Although the illustrative embodiments have been described herein with reference to the accompanying drawings, it is to be understood that the present invention is not limited to those precise embodiments, and that various changes and modifications may be effected therein by one of ordinary skill in the pertinent art
15 without departing from the scope or spirit of the present invention. All such changes and modifications are intended to be included within the scope of the present invention as set forth in the appended claims.